

S268 Physical Resources & the environment

Summaries Block 2

Section 1

1. Stone and other building materials have been used for many thousands of years, hand crafted to make large and complex masonry structures. Only building stone with unusual properties has ever been worth transporting long distances.
2. Today in industrialised societies, the large scale extraction of low-value building materials dominates the industry, leaving large holes in the ground. Materials are usually extracted as close as possible to where they are used in order to minimize transport costs.
3. Physical and mechanical properties, rather than chemical properties, are the most important features of many building materials.

Section 2

1. Building materials can all be related to their conditions of formation in different parts of the rock cycle. Features of building stones like grain size and sorting which control how they behave in use, can be related to the geological conditions under which the rocks were formed.
2. The sequence of rocks formed in the UK over the past 1000 million years can be interpreted from the patterns shown on *the Postcard Geological Map of the UK* (Audio Band 2)
3. Samples of common rocks in the kit are described in Audio Band 3
4. The uses of rocks with different physical properties for various building purposes was illustrated in Video Band 4 *Stones for Building*, based in the Bath area and on the North Brittany coast.
5. The importance of cost, and the crucial contribution that transport makes to building materials, is related to the concept of place value. The lower the cost of the material, the higher its place value.
6. Environmental consequences of building stone extraction include the problems of mine collapse, and groundwater contamination from waste disposal.

Section 3

1. There has been a rapidly rising demand for aggregates this century; the current annual consumption in the UK of about 5 tonnes per capita is towards the lower end of the range of industrialised countries.
2. “Natural aggregates” – sands and gravels – have been the traditional materials used for aggregates.
3. There are large stockpiles of waste material potentially useful for building, and several industries are still generating wastes much faster than they are being used in the building industry. Much more re-use of this material may be possible in the future.
4. In some heavily populated areas, where sands and gravels have traditionally met the local aggregate demand, planning permission for future extraction is becoming more difficult to obtain, casting doubt on the sustainability of this supply.
5. Higher public awareness of environmental issues makes the provision of adequate aggregate reserves for the future an increasing problem.

Section 4

1. Clay minerals form a series of complex layered aluminosilicates, whose crystal structure may accommodate varying amounts of water. This gives them several unique properties.
2. The main use for British clays is in bricks for the building industry
3. Substitution of bricks by concrete and other materials has led to a considerable decline in the quantities of bricks produced since the 1960's
4. Some clays, such as china clays and montmorillonite, are quarried in large quantities for more specialised uses. China clay is an important raw export material from the UK
5. Old brick pits are becoming valuable as sites for waste disposal, and wastes from the china clay and other industries are potentially reusable as building materials.

Section 5

1. Limestone is plentiful in Britain, and there is a wide variety of limestone which is exploited for different purposes. Limestone is widely used for building stones.
2. Limestone is an essential ingredient of concrete, which has become the most important modern building material. It is used in a variety of cement-bound building blocks, which have been substituted for bricks in many uses.
3. Some pure limestones are almost pure calcium carbonate, and so can be worked for the production of chemicals such as calcium oxide, CaO , and calcium hydroxide Ca(OH)_2

Section 6

1. When seawater evaporates in a closed basin, evaporate minerals are formed, in the following sequence of increasing solubility: calcite, gypsum, halite, followed by soluble potassium and magnesium salts.
2. Gypsum, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$, is widely used for the manufacture of plaster, plasterboard and plaster of Paris.
3. Gypsum changes to plaster of Paris in a reversible chemical reaction involving the loss of water.

Section 7

1. Crushed rock aggregates are now consumed in larger quantities than the traditional sands and gravels, and are used largely in concrete and road construction, where their high crushing strength is an advantage.
2. Aggregates for concrete-making must have fragments of a mixture of sizes, they must be well-graded in the engineering sense, so that they pack down to give a strong, low-porosity mass.

3. A rock crushing to make aggregate should itself be of a low porosity to prevent frost damage, and free of particles that react chemically with cement.
4. Aggregates for roads must have a high crushing strength, measured as its aggregate impact value (AIV) in a dynamic test.
5. Aggregates or chippings on a road surface must have a resistance to abrasion, measured as the aggregate abrasion value (AAV), and have high friction, measured as the polished stone value (PSV)
6. High PSV aggregates are not available in many places in the UK, and so some aggregate has to be brought in long distances, especially to the south east of England.

Section 8

1. Aggregate is no longer a cheap material readily available locally all over the country.
2. The trend for the supply of high-quality aggregated has been towards fewer large inland quarries with outputs in the range of 1-5 million tonnes.
3. The perceived environmental disturbance caused by aggregate quarrying is becoming a major factor limiting the opening of new quarries; the NIMBY attitude is now a major factor in the exploitation of aggregates.
4. Recently, coastal super quarries have begun to operate in Scotland, Norway and Nova Scotia, and rock from these quarries is now being supplied to distant coastal markets.
5. Even intercontinental shipment of aggregates has been shown to be feasible with ships of 70000 tonnes.
6. Future pressure for a more sustainable approach to resource exploitation is likely to lead to the greater use of recycled building materials.

Objectives Block 2

1. Explain in your own words and use correctly, the terms in the Glossary relating to Block 2
2. Perform calculations involving tonnages and volumes of building materials, and relate these to areas and volumes of quarries on the ground.

3. Explain the different categories of building materials, and how their properties are utilised in different types of construction.
4. Explain the importance of place value for building materials, and how this varies for different modes of transport.
5. Describe the distribution of building materials in the UK in terms of their ages, as shown on the *Postcard Geological Map*
6. Describe the desirable properties of natural building stones, including the term “freestone”
7. Relate the properties of the rock samples in the rock kit to the properties of large masses of rock used for construction purposes.
8. Explain the origin of sands and gravels being formed today, and relate these to similar materials formed during recent glacial periods.
9. Explain the processes whereby loose sediments are transformed into hard sedimentary rocks.
10. Relate the properties of clay minerals to brick making process
11. Explain the importance of limestone s for the cement industry
12. Relate the formation and properties of gypsum to the processes of evaporation and precipitation
13. Relate the properties that make some rocks sought after as the raw material for crushed –rock aggregates to their distribution in the UK on the *Postcard Geological Map*
14. Relate the properties that can be measured by laboratory tests on rock samples to those needed by aggregates used to make roads
15. Discuss in your own words the concept of sustainability as applied to building materials.
16. Analyse the reasons why there is a trend in the aggregates business from local sand and gravel pits, to fewer larger hard-rock quarries, and then to giant coastal super quarries.